LANGUAGE IMPAIRMENT, FAMILY INTERACTION AND THE DESIGN OF A GAME

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ABSTRACT This case study describes a user-centered design approach in the area of aphasia. Aphasia is a language impairment that can take many forms, so a particular case provides the foundation for this work. The particularities of the individual with this condition and his social context are key to developing and designing an intervention that supports language use and fosters interaction. This article takes the reader through a research process that results in the production of a board game.

This project began with the identification of aphasia as an area with needs, to which visual communication design could make a positive contribution. I recognized the language impairment suffered by people with Broca's aphasia and the consequent lack of interaction with others as important problems, and proposed game-playing and the design of a board game (that involves written and spoken words) to increase opportunities for people with Broca's aphasia to interact with the family and with language. Given the variety among aphasia cases, the project focused on one specific case: an intellectual in his seventies who suffers from Broca's aphasia that in this article will be identified as AM.

The main objective of the game was to increase AM's opportunities to interact with family members. The game *Questions & Answers* was created considering AM's abilities and disabilities so that he could be a successful player, and AM's interests so that he would be motivated to play. The project uses a user-centered design approach, which is critical when working with specific needs and with a disorder like aphasia that varies from case to case.

Two game prototypes were designed to assess size, format, color, typeface selection and other design decisions before the final design. Interviews were held with leading experts in aphasia and in design. Overall, responses by the experts supported the effectiveness of the design strategy. A conversation with the intended user, and his interaction with the prototypes, showed that a board game could increase his opportunities to interact with his family and with language.

As a result of the evaluation, a set of guidelines and a series of recommendations were developed.

WHAT IS APHASIA?

Aphasia is a communication disorder caused by brain damage that effects speech, writing, reading and auditory comprehension to some extent. A person cannot be born with aphasia, it is necessary to have some language in order to acquire the disorder.

Most aphasia cases are caused by stroke. In less than one second the language system is partially or completely damaged. Aphasia can have a devastating effect on the individual's life and his/her entire family.

A feature of aphasia is its variety, and the nature of the impairments depends on the location and size of the lesion. Some people can pronounce only a few words, others mistake words, others cannot speak at all; some cannot read, others can read nouns better than verbs; some cannot write, others can write names; some cannot understand what the other person is saying.

As indicated in the introduction, given the variety among aphasia cases, the project focused on one specific case: AM is an intellectual who suffers from Broca's aphasia. People with this kind of aphasia have their speech reduced to a few words that are pronounced with effort. Basically they cannot verbally construct a complete sentence, they can respond with one or two words, mainly nouns. Writing is normally as impaired as speech. Auditory comprehension and reading are usually intact. This aphasia may be accompanied by paralysis or weakness of the right arm and leg.

Although two people can have the same kind of aphasia, the two cases can be very different. AM was a lawyer and a historian in his seventies when he suffered a stroke. His main activities were to interact socially, to work as a consultant and to read. After the stroke, AM's speech was cut off, his writing abilities were erased, his social life was gone, his professional life finished and he was full of sadness.

The main feature of Broca's aphasia is that it impairs speech, the instrument we use to communicate and socially interact with others. On this topic Hall proposes (1959, p.38):

> To interact with the environment is to be alive, and to fail to do so is to be dead. ...One of the most highly elaborated forms of interaction is speech, which is reinforced by tone of voice and gesture.

WHICH IS THE PROBLEM?

While the type of language impairment differs among cases, those affected by aphasia share similar feelings: sadness, anger, loneliness, depression, frustration, social isolation, fear, uncertainty, anxiety and humiliation.

Returning home is a strong event for people with aphasia; it is at home where the language and physical impairments become exposed. When returning to work full time becomes impossible, financial problems often emerge, increasing the feelings of frustration and despair. Daily life is full of free and unstructured time, but given the impairment, spending time is a difficult task.

Aphasia affects the ability to interact with others, forcing people to stop joking, arguing or chatting with a partner, meeting with friends or playing with grandchildren. Since communicating is frustrating, people with aphasia may not only withdraw from previous social activities and interests, but they may also avoid using language and performing activities where the use of language is necessary.

Family and friends need to adjust to the new situation, look for alternative activities to do at home and provide a supportive context that will increase opportunities for interaction. Simmons-Mackie (2001, p.256) suggested that:

> Partners need to learn how to create an interaction that feels natural and reinforces the confidence and autonomy of the person with aphasia.

Activities are good at providing spontaneous interaction. Communication takes place in the context of activities. In the area of aphasia, activities of choice should be meaningful to the people affected, should provide a supportive context that will encourage the person with aphasia to participate, and should be accessible, recognizing the abilities and disabilities of the person with aphasia.

COULD A BOARD GAME HELP?

When speaking is not possible, or could be frustrating, what kind of strategies can help provide a structure similar to a conversation?

AM used to play games often with the family before his stroke. The topics and formats of the games were varied: cards, dice, dominoes, "Pictionary" or "Trivial Pursuit."

Playing is an activity with significant social function, and its structure could be considered close to that of a conversation. Playing occurs in a meaningful environment, it involves equal and shifting social roles, and varied discourse structures, such as performing actions, joking and gesturing. When playing, first it is your turn, then mine; when conversing first you talk, then I talk. Playing and conversing are constant chains of interactions.

Games are used in education to deliver content in a collaborative environment. The idea of playing has been used in psychology to cope with illness, facilitate family communication and solve family problems. In aphasia therapy, games allow adult

patients to joke and interact with other adults, providing a context in which to express ideas (Boehler, 1984).

A game structure could not only offer possibilities to facilitate family interaction, but also language interaction, through exposure to written and spoken words.

In treatment procedures for reading impairment (*alexia*), reading the same text, oral reading and presenting written words on cards for brief periods have proved beneficial. Beeson and Hillis (2001, p.575, 580) explained:

> Repeated reading of the same text facilitates a shift from letter-by-letter reading to whole-word reading because of clues provided by sentence context and familiarity with the text.
>
> It appeared that brief exposure presentation coupled with corrected oral reading served to strengthen specific graphemic representations (or access to them).

Both the game and the activity could, therefore, create a situation that is supportive and encouraging for AM to interact with his family and with language. A system is therefore created comprising: a tool, in this case a game which facilitates an activity; the activity itself, the playing of the game; and the interaction of the family, facilitated by the playing of the game. The tool, the activity and the family interaction create a situation, structuring the environment in a certain way. If the system is altered, interaction might not be facilitated.

The characteristics of the game to be designed should be based on AM's profile, recognizing his abilities and disabilities so that he can play with confidence and success. The game should also be motivating for AM and his family; and it should provide opportunities for language interaction.

MAIN RESEARCH QUESTION

One of the main objectives of the project was to design a game for people with aphasia, however, I identified a general lack of principles regarding the design of materials, not only games, for these people. Consequently, the main research question that I formulated in order to guide my project was:

> How could visual communication design guidelines be developed for the design of a game to increase opportunities for people with Broca's aphasia to interact with their families and with language?

WHICH RESEARCH METHODS TO USE?

Heuristic evaluation / Expert interviews

In this project, experts in aphasia and in design evaluated the game prototype so that problems could be spotted before the project would be presented to individuals with aphasia. The evaluation was developed during interviews. The experts' comments were verbalized while an assistant and I took notes. The meeting with each expert lasted between one and two hours. To guide the interviews a questionnaire was developed based on a list of topics that emerged from assumptions I developed and uncertainties I identified.

Literature review

To understand and learn about aphasia, I received a reading package from one expert, who also recommended books and articles to read. The reading package was not only efficient for understanding the area, but also for identifying other sources mentioned in the reference lists or in the bibliography of the articles enclosed. To find information for the development of the prototype, a literature review was conducted related to aphasia, design, typography and games.

ABOUT THE DESIGN OF THE PROTOTYPES

Based on the literature review, on knowledge about the user and about design, two prototypes were created (named after the fonts used in their design). The first one called *Goudy*, was later modified creating a second option called *Century*. Both prototypes, *Goudy* and *Century* were shown to the experts in design and in aphasia for advice.

The general design questions were how the game might work and how the game might look. All the questions below were conceived to generate responses related to the intended user.

- How to make the content appropriate and relevant?
- How to make the game adaptable to the needs, skills and interests of the user?
- How to make the elements of the game easy to handle?
- How to make the text comfortably readable?
- How to make the game appealing to the users?
- How to customize the topics?

The content

A literature review provided a possible base for the content of the game. A treatment developed by Helm-Estabrooks and Nicholas was identified as a possibility for the content. *Sentence Production Program for Aphasia* (SPPA) has eight different types of sentences and two levels of difficulty. The aim of the treatment is to improve sentence production in individuals with non-fluent aphasias, which includes Broca's, with an emphasis on functional communications (Helm-Estabrooks and Albert, 2004).

One kind of sentence, *wh–* interrogative sentences (what, who, where and when), at one level of difficulty (level *A)*, was selected to develop the prototype. The goal of the treatment program at the first level is to repeat the key sentence in response to a question. In the *Goudy* prototype, the sentences were very close to the samples proposed by Helm-Estabrooks and Nicholas. Instead, for the *Century* prototype, the texts were shortened. As part of the process of customization and to increase the user's motivation to play, the characters were named after some of his family members.

The elements of the game

To adapt the treatment, the game has question cards and answer cards. The cards have enough space for short sentences, while being close in size to the standard playing cards. If the cards were too big, the game will not look appropriate for adults, and the board will cause problems when using it on tables. A board helps provide a structure to follow the different steps of the game and helps the game look like a game.

A rack facilitates holding the cards for the player with aphasia, avoiding the use of the right hand, while helping him see and read several cards at the same time. A pair of tokens shows who is winning, avoiding confusion and note taking. Given that the person with aphasia has problems with the right hand, the token is on the left of the player (*figures 1 and 2*).

The text

The first step in designing the text was to determine what the user could read. The second step was to consider AM's type style preferences, assessing his age, profession and topics of interest when reading. It was assumed that he was used to reading, and consequently preferred, text set in serif typefaces. When working with stroke patients, it is important to have a typeface with good differentiation between letters. The typeface selected should have distinctive characters; serif typefaces have, in general, more distinctive characters than sans serif fonts.

Under normal circumstances when we recognize a printed word we access its meaning. If the ascenders and descenders are short, word recognition is more difficult. If the word is printed in capitals, the word profile is eliminated and reading is more difficult (Spencer, 1968; Reynolds, 1984; Hartley, 2004). Following this idea, it was important to use upper and lower case, and to select a typeface with visible ascenders and descenders to facilitate word recognition, and activation of meaning.

Reading comprehension is affected to some degree in most individuals with aphasia. The impairment will differ among cases, but some patterns can be recognized. It could be that:

- the vocabulary of written words has been eroded,
- to recognize a word it is necessary to spell it letter-by-letter,
- in order to recognize a letter it has to be traced on the patient's hand,
- patients have problems activating meaning and sounding out words, or
- oral reading is affected.

In most cases the length and the frequency of use of the word should be controlled; long words and low frequency words can be a problem. In cases with an impairment of semantics, words that are semantically related (cat-dog), that look visually similar (same-some), verbs (walk-walked) or prepositions (under-until) can be confused (Beeson and Hillis, 2001).

Considering the patterns of reading impairments in people with aphasia, the *Century* prototype has increased spaces between words to facilitate word recognition. The space between words is constant, to favor legibility (Wiggins, 1967).

Walker (2005) found in her study with children that wider word spacing was helpful for some children; it facilitated word spelling. Bever, Jandreau et al (1990) demonstrated that poor readers do better when increasing spaces between words isolate major sentences. Word spacing should clearly separate the words without disrupting reading (Reynolds, 1984).

It is possible that adults with aphasia have visual impairments, as many other adults do, but they are not able to verbally express the impairment. Prince (1967) advised enlarging the size of punctuation, since it is a subject frequently commented upon in reading tests by people with and without visual impairments. He suggested that the period should be 30 per cent of the height of the lower case "o."

Written language is parallel to speech. Its visual appearance, the layout, should have a clear and accessible structure, helping direct the reader through the text. Waller (1987) called the use of layout to shape arguments 'text–as–diagram.' In a diagram, conceptual relationships are represented by perceptual principles such as proximity, similarity and closure as described by Gestalt psychology.

The reader's performance depends not only on typographic decisions, but also on several other factors like the reader's knowledge, the reading situation and the reader's motivation (Klare, 1984). Klare advised against including new words that the reader does not already have, since it could negatively affect the reader's performance. The reading situation, in this particular case is not a stressful test, but rather a playful

ctivity of the game is to pay attention to questions and to find the right answer. It can be played by 2 or 4
it involves looking, searching and interacting.

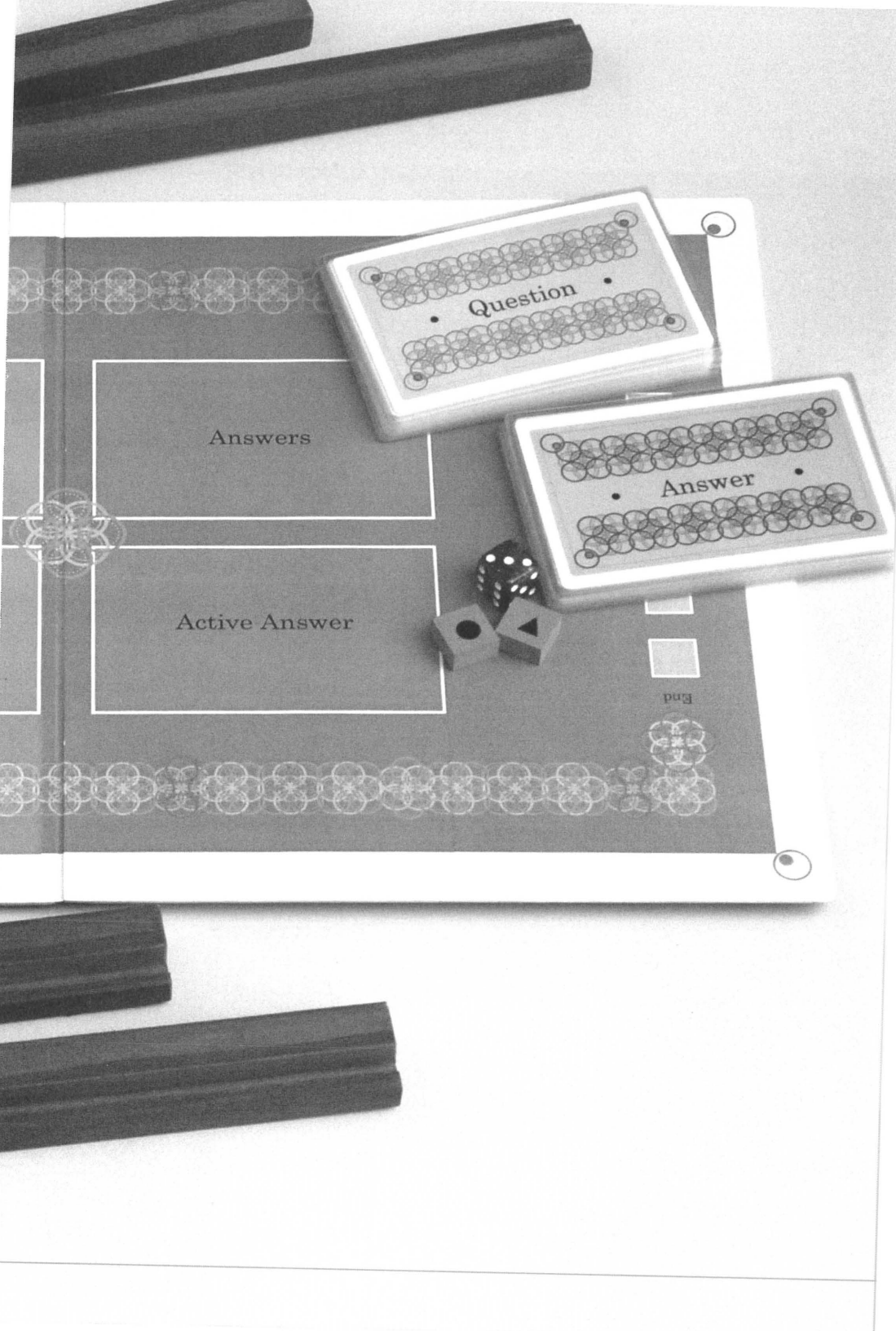
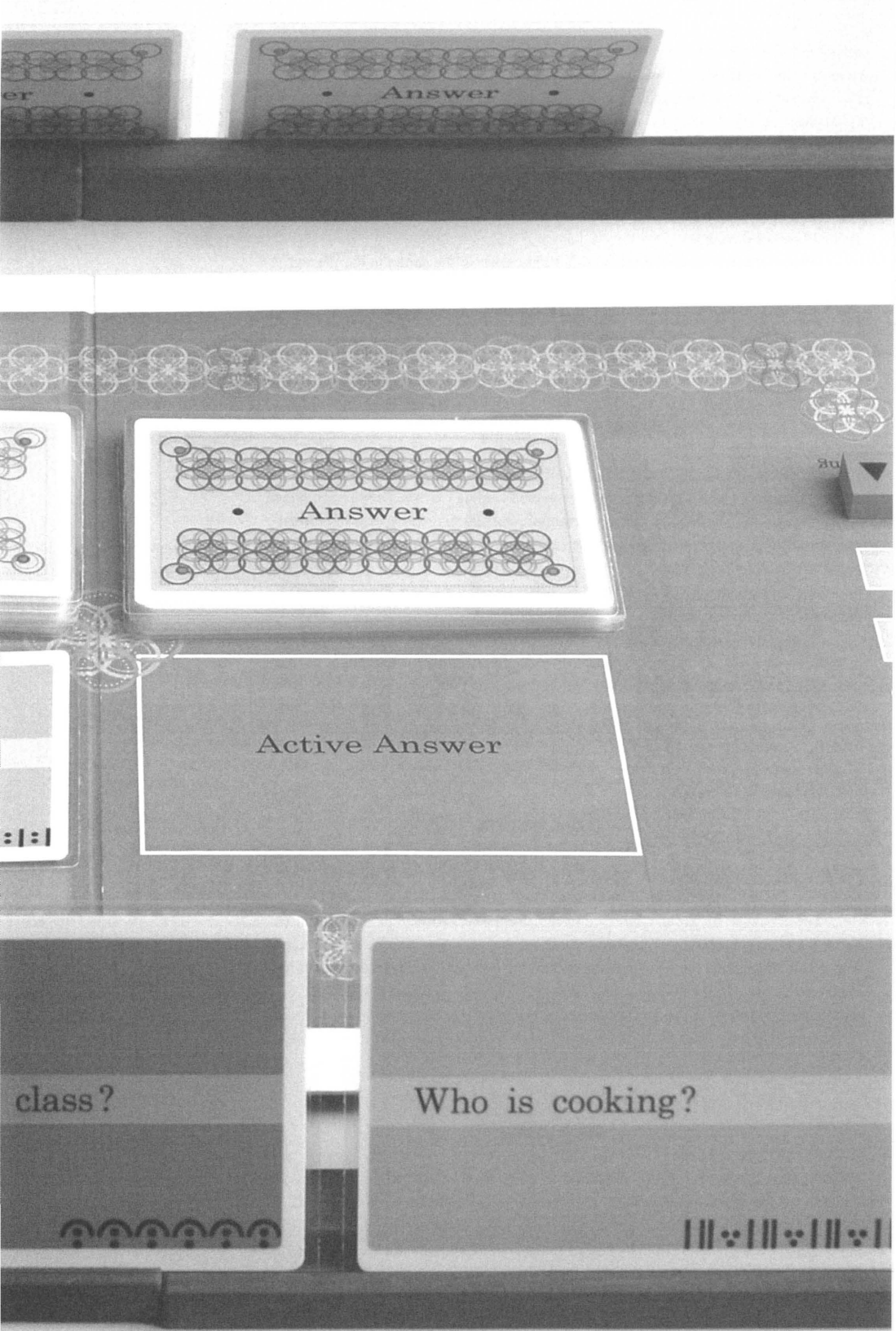

Question
Answer
Answers
Active Answer
End

Figure 2
The first level is aimed at gaining confidence and its main task is matching question cards and answer cards. The second level is aimed at interacting with words; the main task is reading to find the right answer.


Answer
Answer
Active Answer
class?
Who is cooking?

situation that is relaxing. This could foster the reader's motivation, consequently benefiting the reader's performance.

Considering that some individuals with aphasia could have severe reading impairments, a set of patterns was developed to facilitate playing the game by matching patterns, rather than by reading alone. Reading impairments do not necessarily affect pattern perception. According to Julesz (1971), pattern perception is considered spontaneous and requires no learning. Pattern matching is simpler and more accessible than reading, and could help build the confidence of people with aphasia when playing the first level of the game.

The patterns are located in the bottom right corner of the cards; in the Western reading sequence, one begins at the top left and ends at the bottom right. In this way the game invites the users to first look at language (the text) and then attend to the pattern as a final step. The orientation of the patterns is horizontal.

EVALUATING THE PROTOTYPES

Through literature research, some authors were identified as possible experts to contact. Interviews were conducted with seventeen leading experts, people recognized internationally in their fields for their substantial publication records, or professional activities. Eight experts in aphasia and nine experts in design were consulted for their opinions about the prototypes.

The 'Expert interviews' were aimed at collecting opinions from experts, based on their knowledge and experience.

A list of questions was used to guide the experts to focus on certain aspects of the project. These related to playing as an activity to facilitate family interaction for people with Broca's aphasia, the idea of customization, the content, the typeface used, the colors, color to facilitate matching, patterns to facilitate matching, the size of the cards and the board, the use of racks, the layout, the grammar of the sentences and typography.

ANALYZING THE DATA

The first step in the analysis was to select recurrent ideas and units of meaning in the responses and also the reasons behind them.

These units of meaning, expressed in short sentences, were organized in charts under the main subject they addressed (i.e., about the idea of customization). The next step was to understand the main concept behind the units of meaning. All the themes were explained and their relevance and interpretation were analyzed to construct arguments that helped to confirm assumptions and reduce uncertainties regarding the development of guidelines for the design of games for people with Broca's aphasia.

CONCLUSIONS

Overall, responses by the experts in aphasia and in design confirmed that game playing could be an activity to facilitate family interaction for people with Broca's aphasia, and that customization is essential to support the varieties of aphasia. The responses also supported the effectiveness of the design strategy, confirming the assumptions I had. The following guidelines summarizes the findings:

Game playing could facilitate family interaction if the family used to play before the stroke.
– The game should be appropriately designed for people with aphasia, and the family should be instructed about the main purposes of the activity.
– The activity could help avoid social isolation, encouraging people with aphasia to participate in group activities and prompting them to process language, to use nonverbal cognitive skills and to show their preserved skills (those unaffected by the stroke).
– Playing with an appropriate game would promote the wish to communicate without feeling frustration, having favorable psychological consequences.

Customization is essential in relation to motivation and to the specific language deficits the person with aphasia suffers.
– Customization seems to be the strategy to approach varieties of aphasia.
– Customization makes the game more relevant and it carries the connotation of being something special.
– The main problem that customization presents to the production of the game is how to make it adaptable to different persons with aphasia.

The use of color could facilitate matching question cards and answer cards, only if the person is not color-blind or does not have visual problems.
– Given the subtle differences among the colors used in the prototype, the use of color to help matching might not work.
– If the goal is language interaction, through exposure to written and spoken words, color should not be used as a matching tool.

A pattern might facilitate matching question cards and answer cards even if the person with aphasia is color-blind. However, it cannot be said that it will work in all aphasia cases.
– The pattern will allow people with severe reading impairments to play the game, despite their difficulties with language.
– If the goal is reading comprehension, the pattern should be removed.
– The patterns should be different from one another, different from the form of letters, and all should have the same tonal density.
– It would be an advantage if the patterns could easily be described verbally.
– The pattern should be clearly separated from the text.

Increasing the size of punctuation marks could be beneficial, facilitating the recognition of periods, commas and semi-colons.
Increasing the space between words seems to be effective, facilitating the recognition of words.

Color seemed to be an essential element in games' aesthetics helping games to look appealing to the users.

To use the names of the family members could be an advantage, only if they have a good relationship with the person with aphasia, and if the person with aphasia does not have problems with proper names.

A conversation with the intended user also supported the effectiveness of the design

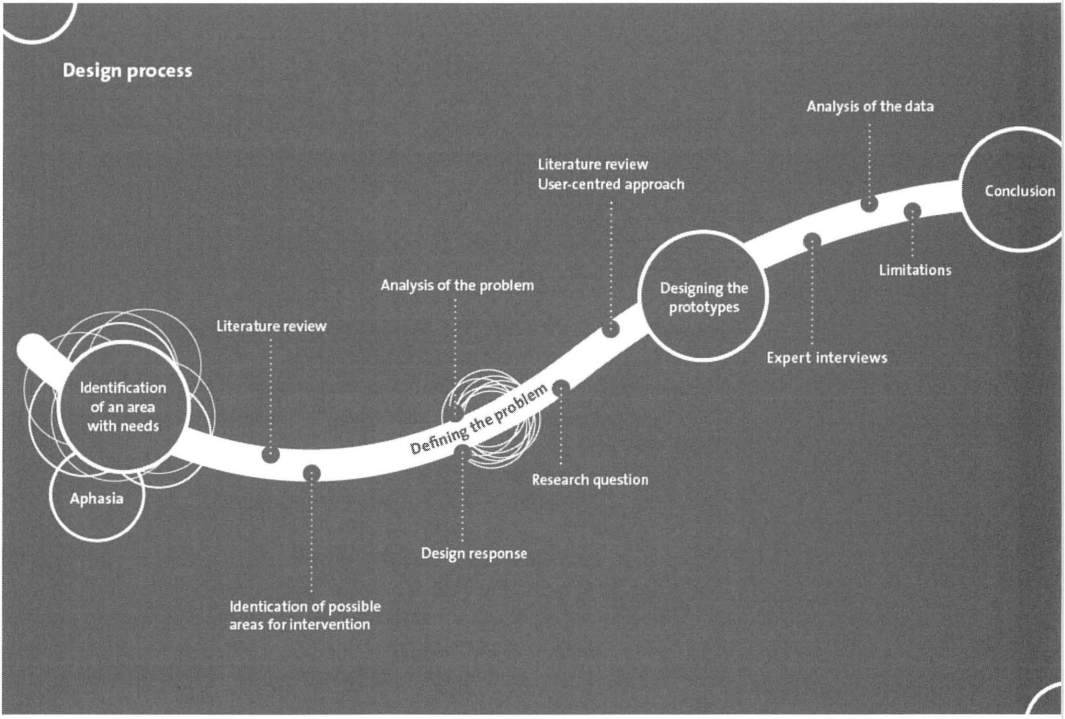


Figure 3 Design process

strategy, the approach and the methods applied.

In conclusion, it seems that there is a possibility for constructive dialogue between design and aphasia experts for the development of materials in different areas of the problem, such as: a) diagnosis, b) rehabilitation and c) general interaction between the sufferers and their environment ('at home').

In an area of highly specialized neurological problems, knowledge in visual communication design can help the development of materials and tools for people who suffer from aphasia.

There might be, of course, other ways to address the problem. Probably the process proposed could be used to develop other tools also in relation to other populations.

This project presented a process to develop guidelines for the design of games, a specific kind of game, aimed at increasing opportunities for a person with Broca's aphasia to interact with the family and with language (*figure 3*).

Applying the concepts learned, two other games were designed for the intended user. The three games designed – the board game *Questions & Answers*, the pairing domino game and the matching card game – were played with the intended user in a family situation and provided joy and interaction. The three games increased AM's opportunities to interact with the family and with language, through exposure to written and spoken words.

The prototype was redesigned following the advice of the experts and the intended user. More cards and a new level of difficulty were developed. The new prototype was used by the team of special educators and patients with aphasia, at the school of the Centennial Centre for Mental Health and Brain Injury in Ponoka, Alberta, Canada. They provided very valuable feedback.

To close, I would recommend that children's materials must not be used for

adults with aphasia. The negative feelings experienced by the users far outweigh the advantages they could offer.

A supportive environment is absolutely necessary: a family or a group of friends willing to interact with the intended user. Simply buying or having the game will not suffice. The family context is an essential dimension, given that it constitutes the main aim of the game: to increase opportunities for family interaction.

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